Specification for Dry Cells and Batteries

Handbook 71

United States Department of Commerce

National Bureau of Standards

THE NATIONAL BUREAU OF STANDARDS

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UNITED STATES DEPARTMENT OF COMMERCE • Frederick H. Mueller, *Secretary*
NATIONAL BUREAU OF STANDARDS • A. V. Astin, *Director*

Specification for Dry Cells and Batteries

By

Sectional Committee on Dry Cells and Batteries—C18

Under the Sponsorship of the
National Bureau of Standards

Approved March 25, 1959, as American Standard, by the
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Preface

The seventh edition of the American Standard Specification for Dry Cells and Batteries contained in this Handbook was approved as American Standard on March 25, 1959. It supersedes the previous specification, which was approved August 19, 1954, and published in Circular 559 of the National Bureau of Standards.

This new standard for dry cells and batteries marks the completion of another step in a project that was begun over 40 years ago. At that time the need for a governmental specification arose as a result of World War I. Since then, manufacturers of dry cells and large industrial users have cooperated with representatives of the Government in perfecting tests and specifications for the varied kinds of dry cells and batteries. This work has been accomplished through a Sectional Committee of the American Standards Association, acting under the sponsorship of the National Bureau of Standards.

New types of cells have been developed to meet new industrial needs and the available electrical output of better brands of the older types has been increased. Successive editions of this specification have reflected these changes. This edition of the specification includes for the first time specifications on cells and batteries for use with transistors; previous editions were confined to specifications for cells and batteries for use with vacuum-tube instruments. This edition of the specification also includes for the first time, dimensions in the metric and English systems and cell designations adopted by the International Electrotechnical Commission.

Advances in the dry-battery industry were made possible by the ability and willingness of battery manufacturers to improve the quality of their product and devise new methods of assembling the final units. The National Bureau of Standards cooperated with them in the tests, specifications, and some phases of research. The Bureau is pleased to have had a part in this work. The resulting benefits accrue to the Government and to the public alike. Future revisions of the specification will undoubtedly become necessary, as they have in the past, because the value of the specifications depends on their keeping pace with the advances made in the art.

A. V. Astin, *Director.*

History of the Project

In 1912, a committee [1] of the American Electrochemical Society recommended standard methods of testing dry cells. Although much has been accomplished in developing specifications for dry cells and batteries since that time, the influence of these early recommendations on some of the later specifications is still discernible.

The preparation of nationally recognized specifications to include sizes of cells, arrangement of batteries, tests, and required performance began in 1917 with the drafting of specifications which were later submitted by the National Bureau of Standards to a committee including representatives of manufacturers, the War Industries Board, and several government departments. The specifications which were approved at that time were published in 1919 as an appendix to the Bureau of Standards circular [2] on dry cells. Within a few years the need for revision became apparent and the Bureau was asked to call a conference of representatives of manufacturers, government departments, and some of the largest individual users of dry cells. This conference met in December 1921 and agreed on a standardization program for sizes of cells and batteries, tests, and performance. New specifications were published in the second edition of the Bureau of Standards' circular [3] on dry cells, and following their adoption as a government standard they were issued separately.[4]

In 1924 a committee consisting of representatives of the Government, battery manufacturers, and several large users of dry cells agreed on a standard system of nomenclature for dry cells and batteries. This has been used in subsequent revisions of the specifications. This committee initiated a movement for a more representative and permanent organization to deal with subsequent revisions of the dry-cell specifications with the result that the American Engineering Standards Committee (now the American Standards Association) authorized the formation of a sectional committee on dry cells under the sponsorship of the National Bureau of Standards. This committee has been active since its organization in 1926 and has prepared seven revisions of the specifications which became American Standards in 1928,[5] 1930,[6] 1937,[7] 1941,[8] 1947,[9] 1955,[10] and 1959.

Close cooperation was maintained between this sectional committee and the technical committee on dry cells reporting to the Federal Specifications Board until April 22, 1952 when the Federal Specification Boards were discontinued and since then with the General Services Administration, with the

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[1] Trans. Am. Electrochem. Soc. c. 21, 275 (1912).
[2] Cir. BS 79, p. 39 (1919).
[3] Cir. BS 79, 2d ed., p. 54 (1923).
[4] Cir. BS 139 (1923); U.S. Government Standard Specification No. 58.
[5] Cir. BS 139, 2d ed. (1927); U.S. Government Master Specification No. 58a; ASA Standard C18-1928.
[6] Cir. BS 390 (1930); ASA Standard C18-1930.
[7] Cir. BS 414 (1937); ASA Standard C18-1937.
[8] Cir. NBS 435; ASA Standard C18-1941.
[9] Cir. NBS 466; ASA Standard C18-1947.
[10] Cir. NBS 559; ASA Standard C18.1-1954, UDC 621.352.7.

result that Federal specifications issued in 1931,[11] 1935,[12] 1948,[13] and 1954,[14] have been concordant with the American Standard specification, although differing in form. The 1935 specification anticipated many of the changes incorporated in the 1937 American Standard but did not include batteries intended primarily for use with hearing-aid devices. The Federal Specification was revised again in 1954.

Periodic revision of the American Standard specifications becomes necessary as a result of changes in the art. New types and uses for batteries require the drafting of new specifications, and the improved performance of batteries, justifies some increase in the requirements. The new specifications, therefore, reflect the advances in the dry-battery industry, and this Handbook includes many new types of mercury cells and a complete revision in their nomenclature. One type given in the 1955 Specification has been eliminated and eleven new types have been added; this change reflects the great advance that has been achieved in mercury cells.

This Handbook, for the first time, contains dry cells and batteries for use with transistor circuits. Batteries for hearing aids are classified as A and B types for use with electron-tube instruments and as transistor types for use with transistor hearing-aid instruments. Transistor batteries for instruments other than hearing aids are also included in this Handbook. New tests have been designed to evaluate these new transistor batteries.

In recent years the use of the No. 6 dry cell in alarm systems has increased to the extent where a new standard test covering them became necessary. Accordingly, this Handbook includes a special test, designated as the alarm battery test, for evaluation of No. 6 dry cells.

Some of the advances made in the performance of batteries during the past years may be judged from the examples listed in the following paragraphs and taken from a paper by Gillingham.[15] Gillingham's performance figures relate to the better brands available at the time, but are not necessarily confined to the product of any particular manufacturer.

The spontaneous shelf deterioration of dry cells of the ordinary No. 6 size for general purposes, occurring in 6 months, was reduced from 35 percent in 1901 to 25 percent in 1916 and to 7 percent in 1934. Since the publication of Gillingham's paper in 1935, the shelf deterioration as observed from tests made during 1950–51 on a number of brands has been further reduced to about 2 percent. Since then no material change in the percentage of shelf deterioration has been noted.

The useful output of dry cells, measured by their service life on various tests, described in the accompanying specifications, has been materially increased. Cells of the telephone type, made in 1910, gave 155 days of service on the light intermittent test; those made in 1916 gave 165 days and the output was increased in 1926 to 230 days. About 1930, special grades of telephone cells became available giving 360 days, and some cells in 1934 reached 450 days. Since then no increases in service life have been noted.

In 1910, flashlight cells of the D size gave 260 minutes of service on the 4-ohm intermittent test whereas today, on the average, cells of this type give 675 minutes with some types giving 930 and 1,000 minutes.

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[11] Federal Standard Stock Catalog, Specification Symbol W-B-101 (March 31, 1931).
[12] Federal Standard Stock Catalog, Specification Symbol W-B-101a (May 7, 1935).
[13] Federal Standard Stock Catalog, Specification Symbol W-B-101b (February 19, 1948).
[14] Federal Standard Stock Catalog, Specification Symbol W-B-101c (November 26, 1954).
[15] Trans Electrochem. Soc. **68**, 159 (1935).

Industrial flashlight cells, intended for heavier service than the ordinary flashlight cells, appeared on the market about 1930, at which time they gave 250 minutes of service on the heavy-industrial test. Subsequent improvements were made rapidly, with the result that 975 minutes of service on the same test were obtainable from cells made in 1935. Results obtained since indicate that no appreciable change has taken place in connection with the heavy-industrial flashlight cell. However, some cells for light-industrial service give about 950 minutes of service.

Radio B batteries, which appeared about 1918, gave 377 hours on the 5,000-ohm continuous test, but in 1926, batteries containing the same size of cell gave 1,000 hours, and this was increased to 1,500 hours of service from batteries made in 1934. No further improvement in radio B batteries as observed on continuous tests have been recorded after 1934 because all continuous tests on B batteries were abolished and replaced by intermittent tests, which are more nearly representative of service conditions.

Hearing-aid A batteries (CD size) gave 18 hours of service in 1932. In 1935, similar batteries gave 50 hours of service whereas today 70 hours of service are obtained on the average. Some further developments have been made in hearing-aid B batteries, which are used with electron-tube-type instruments. These batteries are much smaller than any previously made and give good service at low current drains, even after six months of storage at normal temperatures.

These examples illustrate improvements that are the result of organized research and development on the part of the manufacturers and of standardized test procedures and specifications attained through cooperation of the groups represented on the sectional committee. To allow for manufacturing variations and to obtain adequate competition, it is necessary that the minimum required performance of the various types and sizes of cells included in the specifications be somewhat less than the maximum figures quoted above. The proportion of poorer brands on the market has decreased through the years. The result of all these factors has been a considerable gain to the public at large.

Personnel of Sectional Committee

The personnel of the Sectional Committee on Dry Cells and Batteries, C18 is as follows:

Organization Represented	*Name and Business Affiliation*
American Institute of Electrical Engineers.	W. B. Kouwenhoven, Johns Hopkins University, Baltimore 18, Md.
ASA Sectional Committee on Bioacoustics, S3.	S. F. Lybarger, E. A. Myers & Sons, Inc., 375 Valley Brook Road, Canonsburg, Pa. (Succeeding H. A. Carter, American Medical Society, Chicago, Ill.)
ASA Sectional Committee on Radio, C16.	F. T. Bowditch, National Carbon Co., Cleveland 1, Ohio.
Association of American Railroads, Communication Section.	H. A. Rappaport, Pennsylvania RR, 1034 Transportation Center, 6 Penn Center Plaza, Philadelphia 4, Pa. (Succeeding H. W. Burwell, Louisville & Nashville RR, Louisville 1, Ky.)
Association of American Railroads, Signal Section.	J. A. Balla, Pennsylvania RR, 594 Union Station, Chicago 6, Ill. (Succeeding T. T. Hart, Signal Engr., New York Central Railroad, Syracuse 3, N.Y.)
Bright Star Industries.	F. A. Keller, Bright Star Industries, Clifton, N.J.
Burgess Battery Co.	J. J. Coleman, Burgess Battery Company, Freeport, Ill.
Electrical Testing Laboratories.	H. C. Koenig, Electrical Testing Laboratories, Inc., New York 21, N.Y. Deceased.
The Electrochemical Society, Inc.	J. M. Booe, P. R. Mallory & Co., Inc., Indianapolis 6, Ind.
Electronics Industries Association.	W. S. Skidmore, Radio Corp. of America, Cherry Hill, Camden 8, N.J. (Succeeding L. M. Temple, Richard Puriton, Inc., Hamden, Conn.
Mallory Battery Co.	C. G. Birdsall, Mallory Battery Co., Cleveland, Ohio.
Marathon Battery Co.	G. H. Schroeder, Marathon Battery Co., Wausau, Wis.
National Bureau of Standards.	H. J. DeWane, W. J. Hamer (chairman of Committee), U.S. Department of Commerce, National Bureau of Standards, Washington 25, D.C.
National Carbon Co.	F. J. Wolfe (secretary of Committee), National Carbon Co., Cleveland 1, Ohio.
Ray-O-Vac Co.	R. E. Ramsay, Ray-O-Vac Co., Madison 10, Wis.
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Department of the Navy.	Department of Navy, Bureau of Ships, Code 350, Washington 25, D.C.
Member-at-Large.	W. B. Kouwenhoven, Johns Hopkins University, Baltimore 18, Md.

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Specifications for Dry Cells and Batteries

American Standard C18.1–1959

(Revision of C18.1–1954)

This seventh edition of American Standard Specification for Dry Cells and Batteries, American Standard C18, includes new tests, up-to-date data, and covers new types of dry cells. An alarm test with results on batteries suitable for alarm circuits is a new feature of this seventh edition of the specification. Performance data on flashlight batteries, radio batteries, hearing-aid batteries, etc., have been brought up-to-date. Batteries for use with transistors are included in this specification for the first time.

1. Definitions

1.1. Dry cells and batteries to be included under this specification shall have a nonspillable electrolyte and shall fulfill the requirements in other paragraphs of this specification.

2. Nomenclature

2.1. For reference in this specification, the following systems of nomenclature shall be used to designate sizes and types.

2.2. Cells listed and designated in tables 1A, 1B, and 2 are considered standard. These tables show nominal dimensions over the can for cylindrical cells, but the designations may apply also to cylindrical cells of other dimensions and to cells of other shapes, which, when used in assembled batteries, correspond approximately to the standard size in volume or electrical capacity rating. Such batteries shall be subject to standard dimensions and performance requirements.

TABLE 1A. *Sizes of Leclanche cylindrical cells*

Cell designation	Nominal dimensions [a]				Approximate volume		Approximate weight		IEC designation [b]
	Diameter		Can height						
	Inches	*Millimeters*	*Inches*	*Millimeters*	*Cubic inches*	*Cubic centimeters*	*Pounds*	*Grams*	
No. 6	2½	64	6	152	29. 5	484	2. 2	998	R–40
J	1¼	32	5⅞	149	7. 2	118	0. 6	272	R–27
G	1¼	32	4	102	4. 91	80	. 4	181	R–26
F	1¼	32	3⁷⁄₁₆	87	4. 22	69	. 35	159	R–25
E	1¼	32	2⅞	73	3. 53	58	. 29	132	R–22
D	1¼	32	2¼	57	2. 76	45	. 22	100	R–20
CD	1	25	3³⁄₁₆	81	2. 50	41	. 20	91	R–18
CL	¹⁵⁄₁₆	24	2⅝	67	1. 81	30	. 13	59	R–15
C	¹⁵⁄₁₆	24	1¹³⁄₁₆	46	1. 25	20	. 10	45	R–14
B	¾	19	2⅛	54	0. 94	15	. 077	35	R–12
BR	¾	19	1½	38	. 66	11	. 046	21	
BF	¾	19	1⁵⁄₁₆	33	. 58	10	. 040	18	R–10
A	⅝	16	1⅞	48	. 58	10	. 046	21	R–8
AA	¹⁷⁄₃₂	13	1⅞	48	. 42	7	. 033	15	R–6
AAA	²⁵⁄₆₄	10	1¹¹⁄₁₆	43	. 20	3	. 018	8. 2	R–03
R	¹⁷⁄₃₂	13	1⁵⁄₁₆	33	. 291	5	. 023	10. 4	R–4
N	⁷⁄₁₆	11	1¹⁄₁₆	27	. 160	3	. 012	5. 4	R–1
NS	⁷⁄₁₆	11	¾	19	. 113	2	. 009	4. 1	R–0

[a] Dimensions shown in International Electrotechnical Commission Publication 86—Recommendations for Primary Cells and Batteries—approximate the dimensions shown in this specification. IEC Publication 86 is available from the American Standards Association, Inc., 70 East 45 Street, New York 17, N.Y. at $3.00 per copy.
[b] These designations are given in IEC Publication 86.

Table 1B. *Sizes of mercury cylindrical cells*

Cell designation	Maximum dimensions [a]				Approximate volume		Approximate weight		IEC designation
	Diameter		Overall height						
	Inches	*Millimeters*	*Inches*	*Millimeters*	*Cubic inches*	*Cubic centimeters*	*Ounces*	*Grams*	
M10	0.455	11.56	0.135	3.42	0.02	0.3	0.04	1.1	
M12	.495	12.57	.286	7.26	.06	1.0	.07	2.0	
M15	.455	11.56	.210	5.33	.03	0.5	.08	2.3	
M20	.615	15.62	.238	6.05	.07	1.1	.15	4.3	MR–9
M25	.455	11.56	.570	14.48	.09	1.5	.18	5.1	MR–01
M30	.625	15.88	.440	11.18	.13	2.1	.28	7.9	
M35	.470	11.94	1.130	28.70	.20	3.3	.40	11.3	MR–1
M40	.625	15.88	0.660	16.76	.20	3.3	.43	12.2	MR–7
M50	.640	16.26	1.140	28.96	.37	6.1	.78	22.1	
M55	.546	13.87	1.950	49.53	.46	7.5	1.05	29.8	MR–6
M60	.985	25.02	0.660	16.76	.50	8.2	0.93	26.4	MR–17
M62	1.195	30.35	.510	12.95	.57	9.3	1.20	34.0	
M70	0.625	15.88	1.950	49.53	.60	9.8	1.40	39.7	MR–8
M72	1.225	31.12	0.660	16.76	.78	12.8	1.60	45.4	MR–19
M100	1.281	32.54	2.390	60.71	3.08	50.5	5.85	165.8	

[a] Dimensions shown in IEC Publication 86—Recommendations for Primary Cells and Batteries—approximate the dimensions shown in this specification.

Table 2. *Sizes of standard flat cells*

Cell designation	Nominal dimensions [a]						Approximate cross-sectional area		IEC designation
	Length		Width		Thickness				
	Inches	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Square inches*	*Square centimeters*	
F15	$\frac{9}{16}$	14	$\frac{9}{16}$	14	0.12	3.0	0.32	2.1	F15
F20	$\frac{15}{16}$	24	$\frac{17}{32}$	13	.11	2.8	.50	3.2	F20
F25	$\frac{57}{64}$	23	$\frac{57}{64}$	23	.23	5.8	.79	5.1	F25
F30	$1\frac{1}{4}$	32	$\frac{27}{32}$	21	.13	3.3	1.05	6.8	F30
F40	$1\frac{1}{4}$	32	$\frac{27}{32}$	21	.21	5.3	1.05	6.8	F40
F50	$1\frac{1}{4}$	32	$1\frac{1}{4}$	32	.14	3.6	1.56	10.1	F50
F60	$1\frac{1}{4}$	32	$1\frac{1}{4}$	32	.15	3.8	1.56	10.1	F60
F70	$1\frac{45}{64}$	43	$1\frac{45}{64}$	43	.22	5.6	2.90	18.7	F70
F80	$1\frac{11}{16}$	43	$1\frac{11}{16}$	43	.25	6.4	2.85	18.4	F80
F90	$1\frac{11}{16}$	43	$1\frac{11}{16}$	43	.31	7.9	2.85	18.4	F90
F100	$2\frac{3}{8}$	60	$1\frac{25}{32}$	45	.41	10.4	4.23	27.3	F100

[a] Dimensions shown in IEC Publication 86—Recommendations for Primary Cells and Batteries—approximate the dimensions shown in this specification.

2.3 Assembled batteries are designated by a code system formulated as follows:

(1) The size of cell is indicated by the designations in tables 1A, 1B, and 2.

(2) Preceding the size designation is a numeral showing the number of cells (1.5- or 1.3-volt groups) in series in the battery. If no numeral appears, it is to be understood that the battery is a 1.5- or 1.3-volt battery.

(3) Following the cell-size designation is a numeral indicating the number of cells or groups of cells connected in parallel. If no such parallel-indicating numeral appears, it is to be understood that the battery consists of only a single series group. If there is a possibility of confusion between a cell designation and a parallel-indicating numeral, a dash shall be used to separate them. Thus, 15G2 will represent a 22.5-volt battery of 30 G–size cells connected in groups of 15 in series, 2 groups in parallel, and 15F100–2 will represent a 22.5-volt series parallel battery of 30F100–size cells.

(4) When a small letter "s" or "d" is used at the end of the code, it indicates either of two structural arrangements identical as to number and size of cells and electrical connections; "s" indicating a single, and "d" a double-row arrangement.

3. Nominal Voltages of Dry Batteries

Voltages in (volts) in common use for dry-battery combinations are as follows:

Leclanche	*Leclanche*	*Mercury*
1. 5	22. 5	1. 3
3	30	2. 6
4. 5	33	3. 9
6	45	5. 2
7. 5	67. 5	6. 5
9	90	7. 8
15	300	9. 1

4. General Classification of Cells and Batteries

4.1. The following classes of dry cells and batteries are included in this specification:
(a) General-purpose No. 6 dry cells.
(b) Industrial No. 6 dry cells.
(c) Telephone cells in No. 6, and D sizes.
(d) Assembled batteries of No. 6 cells.
(e) Group batteries of small cells, intended for No. 6 dry-cell applications.
(f) General-purpose flashlight cells.
(g) Industrial flashlight cells and batteries.
(h) Batteries for photoflash lamps.
(i) Batteries for electron tube and transistor hearing aids.
(j) A batteries.
(k) B batteries.
(l) C batteries.
(m) A/B pack batteries.
(n) Transistor batteries for devices other than hearing aids.

5. Standard Sizes of Cells and Batteries

5.1. *No. 6 dry cells.* The dimensions for the container of the cell measured without the jacket, are: diameter, 2½ inches (64 mm); height, 6 inches (152 mm). Deviations shall not exceed 1/16 inch (1.6 mm) in diameter and ⅛ inch (3.2 mm) in height, from the dimensions as given. The overall dimensions, including the jacket and terminals, shall not exceed: height, 6¾ inches (171 mm); diameter, 2⅝ inches (67 mm).

5.2. *Assembled batteries of No. 6 cells.* Standard batteries of this class are shown with their required dimensions in table 3.

TABLE 3. *Assembled batteries of No. 6 cells*

Battery designation	Number of cells in series and arrangement	Nominal battery voltage	Maximum dimensions					
			Length		Width		Overall height	
		Volts	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
4 No. 6s	4 cells, single row	6	10⅝	270	2 13/16	71	7½	190
4 No. 6d	4 cells, double row	6	5⅜	137	5⅜	137	7½	190
5 No. 6d	5 cells, double row	7. 5	8	203	5⅜	137	7½	190
6 No. 6d	6 cells, double row	9	8	203	5⅜	137	7½	190

5.3. *Group batteries of small cells (for No. 6 cell applications).* Cells contained in these batteries may be of various sizes, as preferred by the manufacturer. Batteries shall comply with the dimension requirements of table 4.

5.4. *Flashlight cells and batteries.* Those considered standard are listed in table 5, and shall comply with the dimensions shown therein.

5.5. *Batteries for hearing aids.* These batteries are of several groups, according to the type of instrument for which they are intended, and are so arranged in table 6. Such batteries shall comply with dimensions listed in the table. Codes referring to the various batteries are described in section 2.3.

5.6. *A batteries.* Standard types of A batteries are listed with dimension requirements in table 7. For descriptive code, see section 2.3. A batteries are designed to supply filament current for electron tubes.

5.7. *B batteries.* These batteries are for electron tube plate-current supply and are usually furnished in series-assembled units of 22.5 volts and multiples thereof, as shown in table 8.

5.8. *C batteries.* Standard types are listed with dimensions in table 9. They are intended to supply bias voltage to electron tubes.

Table 4. *Group batteries of small cells*

(No. 6 cell applications)

Nominal battery voltage	Maximum dimensions					
	Length		Width		Overall height	
Volts	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
1.5	$2\frac{5}{8}$	67	$2\frac{5}{8}$	67	$6\frac{1}{4}$	159
3	4	102	$2\frac{3}{4}$	70	$6\frac{1}{4}$	159
4.5	4	102	4	102	$6\frac{1}{4}$	159
6	$2\frac{13}{16}$	71	$8\frac{5}{16}$	211	$6\frac{7}{16}$	164
7.5	$4\frac{1}{16}$	103	$7\frac{5}{16}$	186	$6\frac{7}{16}$	164
9	$4\frac{1}{16}$	103	$8\frac{9}{16}$	217	$6\frac{7}{16}$	164

Table 5. *Flashlight cells and batteries (with jackets)*

Cell or battery designation	Maximum dimensions [a]				Minimum dimensions [a]			
	Diameter		Overall height		Diameter		Overall height	
UNIT CELLS [b]								
	Inches	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
D	$1\frac{11}{32}$	34	$2\frac{13}{32}$	61	$1\frac{9}{32}$	33	$2\frac{5}{16}$	59
C	$1\frac{1}{32}$	26	$1\frac{31}{32}$	50	$\frac{31}{32}$	25	$1\frac{7}{8}$	48
BF	$\frac{27}{32}$	21	$1\frac{15}{32}$	37	$\frac{25}{32}$	20	$1\frac{3}{8}$	35
AA	$\frac{9}{16}$	14	$1\frac{31}{32}$	50	$\frac{17}{32}$	13	$1\frac{29}{32}$	48
AAA	$\frac{13}{32}$	10	$1\frac{3}{4}$	44	$\frac{3}{8}$	10	$1\frac{11}{16}$	43
N	$\frac{29}{64}$	12	$1\frac{3}{16}$	30	$\frac{27}{64}$	11	$1\frac{9}{64}$	29
LANTERN BATTERY								
4F	$3\frac{1}{4}$ [c]	86	4 [d]	102	------	------	$3\frac{13}{16}$	97

[a] See figure 6.
[b] Cells may be supplied as tubular batteries as follows if required: 2D, 3D, 2C, 2BF, 2AA.
[c] Maximum diagonal. This battery must pass through a cylinder 4 inches long and $3\frac{1}{4}$ inches in diameter.
[d] Height over body, exclusive of terminals.

Table 6. *Batteries for hearing aids*

Battery designation		Battery voltage (nominal)	Terminal arrangement [a]	Maximum dimensions							
Cylindrical	Flat			Diameter		Length		Width		Overall height	
PART I. A BATTERIES FOR ELECTRON—TUBE INSTRUMENTS											
		Volts		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
AA	--------	1.5	(b)	$\frac{9}{16}$	14	-----	----	-----	----	$1\frac{31}{32}$	50
AA2	--------	1.5	(b)	----	----	$1\frac{9}{64}$	29	$\frac{19}{32}$	15	$2\frac{1}{64}$	51
A	--------	1.5	(b)	$\frac{41}{64}$	16	-----	----	-----	----	2	51
B	--------	1.5	(b)	$\frac{3}{4}$	19	-----	----	-----	----	$2\frac{3}{16}$	56
C	--------	1.5	(b)	$1\frac{1}{32}$	26	-----	----	-----	----	$1\frac{31}{32}$	50
CL	--------	1.5	(b)	$1\frac{1}{32}$	26	-----	----	-----	----	$2\frac{25}{32}$	71
D	--------	1.5	(b)	$1\frac{11}{32}$	34	-----	----	-----	----	$2\frac{13}{32}$	61
CL	--------	1.5	I	$1\frac{3}{32}$	28	-----	----	-----	----	$3\frac{7}{16}$	87
CD	--------	1.5	I	$1\frac{1}{8}$	29	-----	----	-----	----	4	102
F	--------	1.5	I	$1\frac{11}{32}$	34	-----	----	-----	----	$4\frac{3}{16}$	106
M40	--------	1.3	(b)	0.625	16	-----	----	-----	----	0.660	17
M50	--------	1.3	(b)	.640	16	-----	----	-----	----	1.140	29
M55	--------	1.3	(b)	.546	14	-----	----	-----	----	1.950	50
M60	--------	1.3	(b)	.985	25	-----	----	-----	----	0.660	17
M62	--------	1.3	(b)	1.195	30	-----	----	-----	----	.510	13
M70	--------	1.3	(b)	0.625	16	-----	----	-----	----	1.950	50
M72	--------	1.3	(b)	1.225	31	-----	----	-----	----	0.660	17
PART II. B BATTERIES FOR ELECTRON—TUBE INSTRUMENTS											
--------	10F15	15	(c)	-----	----	$\frac{5}{8}$	16	$\frac{19}{32}$	15	$1\frac{3}{8}$	35
--------	15F15	22.5	(d)	-----	----	$\frac{5}{8}$	16	$\frac{19}{32}$	15	2	51
--------	20F15s	30	(c)	-----	----	$\frac{5}{8}$	16	$\frac{19}{32}$	15	$2\frac{39}{64}$	66
--------	20F15d	30	(e)	-----	----	$1\frac{7}{32}$	31	$\frac{5}{8}$	16	$1\frac{27}{64}$	36
--------	10F20	15	XVI	-----	----	$1\frac{1}{16}$	27	$\frac{5}{8}$	16	$1\frac{1}{2}$	38
--------	15F20	22.5	XVI	-----	----	$1\frac{1}{16}$	27	$\frac{5}{8}$	16	2	51
--------	20F20	30	XVI	-----	----	$1\frac{1}{16}$	27	$\frac{5}{8}$	16	$2\frac{9}{16}$	65
10NS	10F30	15	XVI	-----	----	$1\frac{3}{8}$	35	$1\frac{1}{16}$	27	$1\frac{9}{16}$	40
15NS	15F30	22.5	XVI	-----	----	$1\frac{3}{8}$	35	$1\frac{1}{16}$	27	$2\frac{3}{16}$	56
20NS	20F30	30	XVI	-----	----	$1\frac{3}{8}$	35	$1\frac{1}{16}$	27	$2\frac{13}{16}$	71
15NS	15F30	22.5	VIII	-----	----	$1\frac{3}{8}$	35	$1\frac{1}{16}$	27	$2\frac{3}{4}$	70
20NS	20F30	30	VIII	-----	----	$1\frac{3}{8}$	35	$1\frac{1}{16}$	27	$3\frac{3}{8}$	86
15N	15F40	22.5	VIII	-----	----	$1\frac{13}{32}$	36	$1\frac{1}{16}$	27	$4\frac{1}{32}$	102
22N	22F40	33	VIII	-----	----	$2\frac{21}{32}$	67	$1\frac{1}{16}$	27	$3\frac{1}{8}$	79
30N	30F40	45	VIII	-----	----	$2\frac{21}{32}$	67	$1\frac{1}{16}$	27	$4\frac{1}{32}$	102
PART III. BATTERIES FOR TRANSISTOR INSTRUMENTS											
M10	--------	1.3	(b)	0.455	12	-----	----	-----	----	0.135	3
M12	--------	1.3	(f)	.495	13	-----	----	-----	----	.286	7
M15	--------	1.3	(b)	.455	12	-----	----	-----	----	.210	5
N	--------	1.5	(b)	.453	12	-----	----	-----	----	1.188	30
M20	--------	1.3	(b)	.615	16	-----	----	-----	----	0.238	6
M25	--------	1.3	(b)	.455	12	-----	----	-----	----	.570	14
2M25	--------	2.6	(b)	.485	12	-----	----	-----	----	1.140	29
M35	--------	1.3	(b)	.470	12	-----	----	-----	----	1.130	29
2M35	--------	2.6	(e)	-----	----	0.990	25	0.515	13	1.227	31
M35-2	--------	1.3	(e)	-----	----	.990	25	.515	13	1.227	31
M40	--------	1.3	(b)	.625	16	-----	----	-----	----	0.660	17
2M40	--------	2.6	(b)	.662	17	-----	----	-----	----	1.315	33
2M40D	--------	2.6	(b)	.662	17	-----	----	-----	----	1.965	50
3M40	--------	3.9	(b)	.662	17	-----	----	-----	----	1.965	50
M40-2	--------	1.3	(b)	.657	17	-----	----	-----	----	1.320	34
5M40	--------	6.5	I	-----	----	1.375	35	.662	17	2.125	54

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.
[b] Flashlight-cell terminal.
[c] Flat projecting, one on each end.
[d] Flat recessed, one on each end.
[e] Flat projecting, both on top.
[f] Snap on.

TABLE 7. *A batteries*

Battery designation	Battery voltage (nominal)	Terminal arrangement [a]	Maximum dimensions					
			Length		Width		Overall height	
	Volts		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
F2	1.5	I	2 5/8	67	1 3/8	35	4 1/4	108
F4d	1.5	I	2 5/8	67	2 5/8	67	4 1/8	105
F6d	1.5	I	3 15/16	100	2 3/4	70	4 1/8	105
F8d	1.5	I	3 15/16	100	2 3/4	70	5 1/2	140
3D	4.5	III	4	102	1 3/8	35	3	76
3F	4.5	III	4	102	1 7/16	37	4 1/8	105
3G	4.5	III	4	102	1 7/16	37	4 3/4	121
4Fd	6	IV	2 21/32	67	2 21/32	67	4 1/4	108
4F2s	6	IV	3 15/16	100	1 7/16	37	10 7/8	276

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.

TABLE 8. *B batteries*

Battery designation		Battery voltage (nominal)	Terminal arrangement [a]	Maximum dimensions					
Cylindrical	Flat			Length		Width		Overall height	
		Volts		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
----------	15F20	22.5	XVI	1 1/16	27	5/8	16	2	51
----------	20F20	30	XVI	1 1/16	27	5/8	16	2 9/16	65
----------	45F25	67.5	XV [b]	1 59/64	49	1 1/64	26	5 9/16	141
----------	60F25	90	XV [b]	1 31/32	50	1 1/32	26	7 15/32	190
15NS	15F30	22.5	XVI	1 3/8	35	1 1/16	27	2 7/32	56
20NS	20F30	30	XVI	1 3/8	35	1 1/16	27	2 13/16	71
45NS	45F30	67.5	XV	2 13/16	71	1 3/8	35	2 1/2	64
30N	30F40	45	XV	2 21/32	75	1	25	3 3/4	95
45N	45F40	67.5	XV	2 13/16	71	1 3/8	35	3 13/16	97
60N	60F40	90	XV [c]	3 23/32	94	1 3/8	35	3 3/4	95
30AA	30F70	45	IX or X	3 1/8	79	2 3/8	60	4 3/16	106
15A	15F80	22.5	Screw	3 17/32	90	2 3/16	56	2 15/16	75
30A	30F80	45	IX or X	3 9/16	90	2 5/16	59	4 5/8	117
30BR	30F90	45	IX or X	3 5/8	92	1 27/32	47	5 5/8	143
15B	--------	22.5	XII	4 1/4	108	2 5/8	67	3 5/16	84
30B	--------	45	IX or X	4 3/8	111	2 11/16	68	5 1/2	140
----------	30F100	45	VII	5 1/8	130	2 1/16	52	7 1/4	184
30D	--------	45	VII	8 1/4	210	3 5/16	84	7 5/8	194
30F	--------	45	VII [d]	8 1/4	210	4 1/2	114	7 5/8	194
30G	--------	45	VII	8 1/4	210	4 9/16	116	7 11/16	195

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.
[b] Spacing for snap terminals to be 0.937±0.015 inches, center to center, instead of 1.5 inches as shown and terminals to be on center.
[c] Spacing for snap terminals to be 2.5±0.015 inches, center to center, instead of 1.5 inches as shown.
[d] May have spring clip terminal when specified.

TABLE 9. *C batteries*

Battery designation	Battery voltage (nominal)	Terminal arrangement [a]	Maximum dimensions					
			Length		Width		Overall height	
	Volts		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
3B	4.5	Screw [b]	2 1/2	63	7/8	22	3 5/32	80
5B	7.5	(c)	4 1/4	108	15/16	24	3 5/16	84
15B	22.5	XII	4 1/4	108	2 5/8	67	3 1/16	78
3D	4.5	XI	4 1/16	103	1 1/2	38	3 1/16	78
200F20	300	XVIII	2 11/16	68	2 7/32	56	3 29/32	99

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.
[b] Screw or flat-spring type.
[c] One flexible wire at 7.5 volts and 5 screw terminals.

5.9. *A/B pack batteries.* Batteries in this classification comprise a suitable combination of A and B units assembled in a single battery. Standard types are listed with dimension requirements in table 10.

5.10. *Transistor batteries.* Standard types of transistor batteries are listed with dimensions in table 11. These batteries are designed to supply power to transistor circuits.

TABLE 10. *A/B Pack batteries*

Battery designation	Battery voltage (nominal)		Terminal arrangement [a]	Maximum dimensions					
	A	B		Length		Width		Overall height	
	Volts	*Volts*		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
60AA/6CD	9, 7.5	90	XIV	8 7/8	225	2 1/8	54	3 25/32	96
60A/6F	9, 7.5	90	XIV	9 5/8	244	2 7/8	73	4 1/2	114
60BR/6G	9, 7.5	90	XIV	10 9/16	268	3 3/8	86	4 5/16	110
60D/F18	1.5	90	XIII	16	406	4 1/2	114	7 1/16	179

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.

TABLE 11. *Transistor batteries*

Battery designation	Battery voltage (nominal)	Terminal arrangement [a]	Maximum dimensions							
			Diameter		Length		Width		Overall height	
	Volts		*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
AA	1. 5	([b])	9/16	14	------	----	------	----	1 31/32	50
C	1. 5	([b])	1 1/32	26	------	----	------	----	1 31/32	50
D	1. 5	([b])	1 11/32	34	------	----	------	----	2 13/32	61
6F25	9. 0	([c])	------	----	1	25	1	25	1 61/64	50
6F50–2	9. 0	XVII [d]	------	----	1 3/8	35	1 13/32	36	2 3/4	70
6F100	9. 0	XV [e]	------	----	2 9/16	65	2 1/32	52	3 5/32	80

[a] Terminal designations in Roman numerals refer to terminals shown in figures 1 through 5.
[b] Flashlight-cell terminal.
[c] One snap fastener terminal centered on each end of battery.
[d] Miniature snap fastener terminals spaced ½ ±0.010 inch apart on the top of battery and on center line.
[e] Snap fastener terminals spaced 1⅜ ±0.010 inches apart on long center line and centered on top of battery.

6. Material and Workmanship

6.1. Material and workmanship shall be first class in every particular. Cells or batteries having any of the following defects shall be considered as not complying with this part of the specification: Loose terminals, spring clips, or plug-in terminals that do not make and maintain positive connections to the external circuit, corrosion of terminals, loose or broken seals, leaking or distorted containers. Cells and assembled batteries shall be free from deformation and leakage during their useful life under specified test conditions (see section 13).

7. Jackets

7.1. Single No. 6 dry cells and flashlight type unit cells shall be enclosed in close-fitting jackets, usually of paperboard, but may be of plastic or other suitable material. For special purposes, jackets may be treated when so specified with paraffin or other water-proofing material. When metal-clad jackets are provided on unit cells, they shall be insulated from both terminals of the cell, and shall be covered outside with insulating material that is adherent and resistant to penetration by exposed metal switch parts of flashlights or other equipment in which the cells are used.

8. Marking

8.1. On the outside of the jackets of unit cells and outside of batteries, the following information shall be printed:

The trade name of the cell or battery.

The name or trade-mark of the manufacturer or supplier.

The type number or other designation of size.

The coded date of manufacture, or the expiration of a guaranty period, indicated as such. (Option: This may be shown on the individual cell container, provided the jacket is removable.)

Socket terminals shall be located on the top of the battery, and the polarity shall be clearly marked.

9. Top Closure for Cells and Batteries

9.1. Sealing compound used for closing cells and batteries at the top shall be an insulating material that will not flow at a temperature of 113° F (45° C) during a static test, in which the sealed surface is held vertical for a period of 24 hours.

9.2. Metal or composition covers for tops of cells may be used in lieu of sealing compound, provided such covers and accessory parts shall not become adversely affected by leakage, corrosion, or deformation during the useful life of the cell.

9.3. Metal boxes and covers of assembled batteries shall, unless otherwise specified, be insulated from the cells comprising the battery. The top closure may be metal, fiber, paperboard, sealing compound, or plastic.

10. Battery Connections

10.1. In all assembled batteries, electrical connections between cells, and between cells and terminals shall be secure and permanent.

10.2. All soldered connections shall be made in such a manner as not to interfere with subsequent battery performance.

10.3. Welded or solderless wrapped connections, where practicable, may be used in lieu of soldered connections, provided they are equally permanent.

11. Terminals

11.1. Terminals in common use for batteries of various classifications are as follows:

(a) KNURLED-NUT AND SCREW TERMINALS. These shall have standard 8–32 threads and shall be of brass or other suitable metal.

(b) SPRING-CLIP TERMINALS. These shall be of spring brass or other material of equivalent properties.

(c) FLASHLIGHT-CELL TERMINALS. In the case of flashlight cells, the metal cap on the carbon electrode and the bottom of the cell may serve as the terminals.

(d) FLAT- OR SPIRAL-SPRING TERMINALS. These terminals shall consist of either flat-metal strips or spirally-wound wire, in a form suitable to provide a pressure contact. They shall be made of spring brass, or other metal of equivalent properties.

(e) WIRE TERMINALS. These shall be flexible insulated tinned copper conductor and may be covered with single cotton braid or suitable plastic if so specified. The positive terminal wire covering shall be red and the negative, black. Unless otherwise specified, the size of wire shall be equivalent to No. 18 (AWG), and the length shall be 6 $\pm$½ inches. When the free ends of wire terminals are stripped bare, the separate strands shall be soldered together at the tip. Under certain circumstances wire terminals may be required to terminate with a ring, open-ring, soldering lug, or other type of connector.

(f) "PLUG-IN" SOCKETS. This type of terminal shall consist of a suitable assembly of metal contacts, mounted in an insulating housing or holder and adapted to receive corresponding pins of a mating plug in such manner as to make good electrical contact. The metal contacts shall be of tinned brass or other equally suitable metal. Dimensions and arrangement

of socket contacts shall be in conformity with figures 1 and 2 for various voltages as required and not exceeding 100 volts. For high-voltage batteries, such as the battery designated 200F20, the terminals shall be of the flush pin jack type with spacing and marking as shown in figure 5, XVIII. These terminals are located on top of the battery on a center line through the sockets 3/16 inch from the front of the battery.

(g) SNAP-FASTENER TERMINALS. This type of terminal consists of a combination comprising a stud for the positive and a socket for the negative terminal, as illustrated in figures 3 and 5. These shall be made from tinned brass or other suitable metal. They shall be designed in such a way as to provide a secure electrical connection when fitted with corresponding parts for connection to an electrical circuit.

(h) FLAT CONTACT TERMINALS. These shall be essentially a flat metal surface, as shown in figure 4, or as recommended in footnotes c, d, and e of table 6, adapted to make electrical contact by suitable contacting mechanisms bearing against them. In the subminiature hearing-aid B batteries, all flat terminals shall project beyond the body of the battery, except in the case of the battery designated 15F15, where the flat terminals shall be recessed. This is done to avoid the possible error of interchanging this B battery and the A battery (size AA) in a hearing-aid instrument.

11.2. *No. 6 cells.* These shall be equipped with terminals of either the knurled-nut and screw type or with spring clips, as required. Spacing between centers of screw terminals shall be 1 1/16 $\pm$1/16 inch. In the case of spring-clip terminals the design and location of the negative terminal shall be such that no part of it will extend outside the periphery of the jacket when the connecting wire is in place.

11.3. *Assembled batteries of No. 6 cells* (*table 3*). These shall be equipped with terminals of either the knurled-nut and screw, or spring-clip type as required. Terminals shall be located on the top of the battery and the polarity of each shall be clearly marked.

11.4. *Group batteries of small cells* (*table 4*). These batteries shall have terminals similar to those used on No. 6 dry cells.

11.5. *Flashlight cells* (*table 5*). Terminals for these shall be as described in 11.1(c). The positive terminal shall be centrally located at the top of the cell and the negative shall be centrally located at the bottom. They shall be clean to assure good electrical contact.

11.6. *Lantern batteries* (*table 5*). Terminals shall be of flat- or spiral-spring type brought out through the cover at the top. The point of contact of one terminal shall be centrally located and that of the other 1 $\pm$1/16 inch from it. The polarity of each shall be clearly marked.

11.7. *Hearing-aid batteries.* Terminals for hearing-aid batteries shall be as specified in table 6. It is especially important in hearing-aid batteries that the terminals be such that good contact is maintained at all times with the instrument terminals in order to avoid noise and unsatisfactory reception and that they shall preferably be of such design that reversal of polarity is impossible.

11.8. *A, B, C batteries, A/B Pack batteries and transistor batteries* (*tables 7, 8, 9, 10 and 11*). Terminals for these batteries shall be as called for in the tables.

12. Voltage Tests

12.1 Voltage tests are intended to apply to fresh cells or batteries and shall be made within 30 days of receipt of samples by the testing agency. The samples shall have been subjected to a temperature of 70 $\pm$2° F (21° C) for a long enough period (at least 24 hours) to have become stabilized at this temperature before the measurements are made.

12.2. The voltmeter used shall meet the following requirements:

(a) The voltmeter shall have an accuracy at least of 0.5 percent of full-scale deflection. The resistance shall be 1,000 ohms per volt of full-scale deflection for cells larger than F20, and 10,000 ohms per volt or higher for cells of F20 size or smaller.

(b) When used to measure individual cells, the scale shall have not less than 50 divisions per volt.

(c) When used to measure batteries of two or more cells, the scale shall have not less than 100 divisions, and the full-scale reading shall preferably be about 2 volts per cell in series and shall not exceed 5 volts per cell.

(d) When measured under the above conditions the voltage of the cell or battery shall equal or be greater than the specified nominal voltage.

13. Capacity Tests

13.1. The size and kind of dry cell or battery and the conditions of service determine the kind of test to be applied. The test that best represents any particular service is that which most nearly duplicates the power output of the battery when in actual use. Intermittent tests are preferred to continuous tests and shall be used whenever possible because they usually simulate service conditions more closely. Generally, there is no direct relation between the results of continuous and intermittent tests.

"Initial" tests intended to show the condition of fresh batteries shall be started within 30 days of the receipt of the batteries by the testing agency. All tests not otherwise designated shall be understood to be "initial" tests.

"Delayed" tests are intended to measure the keeping quality of cells and batteries. Cells and batteries for delayed test shall be stored on open circuit at an even temperature of $70 \pm 2°$ F (21° C) for the time specified in section 14. The storage time specified shall be measured from the time at which the batteries were received by the testing agency.

The standard temperature for tests is $70 \pm 2°$ F (21° C) unless otherwise specified. Deviations from this temperature shall be stated.

The resistance of the discharge circuit shall be maintained within 0.5 percent of its nominal value.

In making capacity tests, readings of the closed-circuit voltage shall be taken with a voltmeter conforming to the requirements of paragraph 12.2.

To determine compliance with this Specification, those tests shall be applied for which requirement data are given in tables 11 to 21, inclusive.

In the tests described below, the frequency of readings specified for each test relates to the larger and more commonly used sizes of cells and batteries. When the smaller sizes are tested, more frequent readings are required.

13.2 *Description of Tests.*

(1) LIGHT INTERMITTENT TEST. Three cells connected in series shall be discharged through a resistance of 20 ohms for 10 periods of 4 minutes each, beginning at hourly intervals during 6 days per week. On the remaining day, every other discharge period shall be omitted. (There are 65 such discharge periods per week, or a total weekly service of 260 minutes).

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage, and the closed-circuit voltage at the end of the 10th discharge of each succeeding 7th day.

The test shall be continued until the closed-circuit voltage of the battery falls below 2.8 volts. The service shall be reported as the number of days on test before battery voltage falls below 2.8 volts.

(2) FIFTY-OHM TELEPHONE TEST. This test shall be conducted exactly as called for in section (1) above, except that the three cells shall be discharged through 50 instead of 20 ohms, and the cutoff voltage shall be 3.25 instead of 2.8 volts.

(3) ALARM BATTERY TEST. The battery shall be discharged continuously through a resistance of 300 ohms for each cell in series.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage, and the closed-circuit voltage at the end of each 7 days of service.

The test shall be continued until the closed-circuit voltage falls below 0.90 volt per cell. The service shall be reported as the total number of days on test before battery voltage falls below 0.90 volt per cell.

(4) HEAVY INTERMITTENT TEST. The battery shall be discharged through a resistance of 2⅔ ohms for each cell in series for two periods of 1 hour each daily according to the following schedule:

1-hour discharge. 6-hour rest. 1 hour discharge. 16-hour rest.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage, and the closed-circuit voltage every alternate working day thereafter at the end of the second discharge period of the day.

The test shall be continued until the closed-circuit voltage of the battery falls below 0.85 volt per cell. The service shall be reported as the number of hours of discharge before battery voltage falls below 0.85 volt per cell.

(5) GENERAL-PURPOSE 5-OHM INTERMITTENT TEST. Each cell shall be discharged through a resistance of 5 ohms for 5-minute periods at 24-hour intervals.

The following readings shall be taken: Initial open-circuit voltage of the cell; initial closed-circuit voltage, and the closed-circuit voltage at the end of each discharge period.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.75 volt. The service shall be reported as the number of minutes of discharge before the cell voltage falls below 0.75 volt.

(6) GENERAL-PURPOSE 4-OHM INTERMITTENT TEST. Each cell shall be discharged through a resistance of 4 ohms for 5-minute periods at 24-hour intervals.

The following readings shall be taken: Initial open-circuit voltage of the cell; initial closed-circuit voltage, and the closed-circuit voltage at the end of a discharge period twice each week thereafter.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.75 volt. The service shall be reported as the number of minutes of discharge before the cell voltage falls below 0.75 volt.

(7) GENERAL-PURPOSE 2.25-OHM INTERMITTENT TEST. Each cell shall be discharged through a resistance of 2.25 ohms for 5-minute periods at 24-hour intervals.

The following readings shall be taken: Initial open-circuit voltage of the cell; initial closed-circuit voltage, and the closed-circuit voltage at the end of a discharge period twice each week thereafter.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.65 volt. The service shall be reported as the number of minutes of discharge before the cell voltage falls below 0.65 volt.

(8) LIGHT-INDUSTRIAL FLASHLIGHT CELL TEST. Each cell shall be discharged through a resistance of 4 ohms for 4-minute periods, beginning at hourly intervals for 8 consecutive hours each day, with 16-hour rest periods intervening. (There are eight such discharge periods each day, or a total daily discharge of 32 minutes.)

The following readings shall be taken: Initial open-circuit voltage of the cell; initial closed-circuit voltage, and the closed-circuit voltage daily at the end of the last discharge period.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.90 volt. The service of general-purpose flashlight cells shall be reported as the number of minutes of discharge before the cell voltage falls below 0.90 volt. The service of industrial flashlight cells shall be reported as the number of minutes of discharge before the cell voltage falls below 1.10 and 0.90 volts.

(9) HEAVY-INDUSTRIAL FLASHLIGHT CELL TEST. Each cell shall be discharged through a resistance of 4 ohms for 4-minute periods, beginning at 15-minute intervals, for 8 consecutive hours every day, with 16-hour rest periods intervening. (There are 32 such discharge periods each day, or a total daily discharge of 128 minutes.)

The following readings shall be taken: Initial open-circuit voltage of the cell; initial closed-circuit voltage; and the closed-circuit voltage at the end of the 16th and 32d discharge periods daily.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.90 volt. The service shall be reported as the number of minutes of discharge before the cell voltage falls below 1.10 and 0.90 volts.

(10) PHOTOFLASH CELL TEST. Each cell shall be discharged through a resistance of 0.15 ohm for 1 second each minute for 1 hour (one discharge per minute) at 24-hour intervals for 5 consecutive days each week.

The following readings shall be taken: Initial open-circuit voltage of the cell; the closed-circuit voltage on the 1st, 30th and 60th discharge daily.

The test shall be continued until the closed-circuit voltage of the cell falls below 0.50 volt for a D-size cell and 0.25 volt for AA-size and C-size cells. The service shall be reported as the number of seconds of discharge before the cell voltage falls below, respectively, 0.50 and 0.25 volt.

(11) 32-OHM LANTERN BATTERY TEST. The battery shall be discharged every day during 8 periods of 30 minutes each, beginning at intervals of 1 hour for 8 consecutive hours, through a resistance of 32 ohms.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; and the closed-circuit voltage daily thereafter, at the end of the last discharge period of the day.

The test shall be continued until the closed-circuit voltage of the battery is below 3.6 volts. The service shall be reported as the number of hours of discharge before the battery voltage falls below 3.6 volts.

(12) 16 OHM LANTERN BATTERY TEST. The battery shall be discharged every day during 8 periods of 30 minutes each, beginning at intervals of 1 hour for 8 consecutive hours, through a resistance of 16 ohms.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; and the closed-circuit voltage daily thereafter, at the end of the last discharge period of the day.

The test shall be continued until the closed-circuit voltage of the battery is below 3.0 volts. The service shall be reported as the number of hours of discharge before the battery voltage falls below 3.0 volts.

(13) HEARING-AID A-BATTERY TEST, 20 OHMS. The battery shall be discharged through a resistance of 20 ohms for each cell in series, for one continuous 12-hour period each day.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; and the closed-circuit voltage at the end of each 12-hour period of discharge, with readings during the discharge period, if necessary, to determine accurately the end of the test.

The test shall be continued until the closed-circuit voltage falls below 0.90 volt per cell. The service shall be reported as the number of hours of discharge before the battery voltage falls below 0.9 volt per cell.

(14) HEARING-AID A-BATTERY TEST, 30 OHMS. This test shall be as specified in paragraph (13) of section 13.2, with the exception that 30 ohms shall be used in place of 20 ohms.

(15) HEARING-AID A-BATTERY TEST, 50 OHMS. This test shall be as specified in paragraph (13) of section 13.2, with the exception that 50 ohms shall be used in place of 20 ohms.

(16) HEARING-AID B-BATTERY TEST, 1,500 OHMS. The battery shall be discharged through a resistance of 1,500 ohms for each cell in series for one continuous 12-hour period each day. The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; and the closed-circuit voltage at the end of each discharge period.

The test shall be continued until the closed-circuit voltage falls below 1.0 volt per cell. The service shall be reported as the number of hours of discharge before the battery voltage falls below 1.0 volt per cell.

(17) HEARING-AID B-BATTERY TEST, 3,000 OHMS. This test shall be as specified in paragraph (16) of section 13.2, with the exception that 3,000 ohms shall be used in place of 1,500 ohms.

(18) HEARING-AID B-BATTERY TEST, 6,000 OHMS. This test shall be as specified in paragraph (16) of section 13.2, with the exception that 6,000 ohms shall be used in place of 1,500 ohms.

(19) HEARING-AID TRANSISTOR BATTERY TEST, 250 OHMS. The battery shall be discharged through a resistance of 250 ohms for each cell in series, for one continuous 12-hour period each day.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; the closed-circuit voltage at the end of each 12-hour period of discharge, with readings during the discharge period, if necessary, to determine accurately the end of the test.

The test shall be continued until the closed-circuit voltage falls below 0.90 volt per cell. The service shall be reported as the number of hours of discharge before the battery voltage falls below 0.90 volt per cell.

(20) HEARING-AID TRANSISTOR BATTERY TEST, 625 OHMS. This test shall be as specified in paragraph (19) of section 13.2 with the exception that 625 ohms shall be used in place of 250 ohms.

(21) A-BATTERY TEST, 5 OHMS. Each complete 1.5-volt battery shall be discharged through a resistance of 5 ohms, during a continuous period of 4 hours daily.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; closed-circuit voltage at the end of alternate discharge periods.

The test shall be continued until the closed-circuit voltage falls below 1.0 volt. The service shall be reported as the number of hours of discharge before the battery voltage falls below 1.1 and 1.0 volts.

(22) A-BATTERY TEST, 25 OHMS. Each complete battery shall be discharged through a resistance of 25 ohms for each 1.5 volts of nominal battery voltage during a continuous period of 4 hours daily.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; closed-circuit voltage at the end of alternate discharge periods.

The test shall be continued until the closed-circuit voltage falls below 1.0 volt per cell in series in the battery. The service shall be reported as the number of hours of discharge before the battery voltage falls below 1.1 and 1.0 volts per cell.

(23) B-BATTERY TEST, 1,250 OHMS. Each 22.5-volt (nominal voltage) battery unit shall be discharged through a resistance of 1,250 ohms during a continuous period of 4 hours daily, the intervals between successive discharge periods being not less than 16 hours. For batteries other than 22.5-volt batteries, the resistance shall be 1,250 times the nominal battery voltage, divided by 22.5.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; closed-circuit voltage at the end of alternate discharge periods.

The test shall be continued until the closed-circuit voltage falls below 15 volts, or the nominal voltage divided by 1.5. The service shall be reported as the number of hours of discharge before the battery voltage falls below 15 volts, or the nominal voltage divided by 1.5.

(24) B-BATTERY TEST, 2,500 OHMS. This test shall be as specified in paragraph (23) of Section 13.2 with the exception that 2,500 ohms shall be used in place of 1,250 ohms.

(25) B-BATTERY TEST, 22,500 OHMS. This test shall be as specified in paragraph (23) of section 13.2 with the exception that 22,500 ohms shall be used in place of 1,250 ohms.

(26) C-BATTERY TEST. The C batteries shall be stored on open circuit at a temperature of $70° \pm 2°$ F. Voltage readings shall be taken at intervals not exceeding 1 month.

The test shall continue until the open-circuit voltage falls below 1.45 volts per cell. The service shall be reported as the number of months until the battery voltage falls below 1.45 volts per cell.

(27) A/B-PACK BATTERY TESTS. A/B-pack batteries shall be subjected to the same test for their A and B sections as are applicable, respectively, to separate A and B batteries of the same cell sizes. The service shall be reported as the number of hours of discharge until the

battery voltage falls below 1.0 volt per cell in series for the A section or below 15 volts per 22.5 volt unit for the B section, whichever is the smaller number.

(28) TRANSISTOR BATTERY TEST, 83⅓ OHMS. Each complete battery shall be discharged through a resistance of 83⅓ ohms for each 1.5 volts of nominal battery voltage during a continuous period of 4 hours daily.

The following readings shall be taken: Initial open-circuit voltage of the battery; initial closed-circuit voltage; closed-circuit voltage at the end of alternate discharge periods.

The test shall be continued until the closed-circuit voltage falls below 0.9 volt per cell in series in the battery. The service shall be reported as the number of hours of discharge before the battery voltage falls below 0.9 volt per cell in series.

(29) TRANSISTOR BATTERY TEST, 166⅔ OHMS. This test shall be as specified in paragraph (28) of Section 13.2 with the exception that 166⅔ ohms shall be used in place of 83⅓ ohms.

14. Required Average Performance

Batteries and cells of the various types and sizes shall comply with the performance requirements listed in tables 12 to 21, inclusive, as indicated below:

	Table
(a) No. 6 dry cells	12
(b) Group batteries of small cells intended as equivalent to No. 6 cells shall meet the requirements shown for the corresponding type of No. 6 cell in	12
(c) General-purpose flashlight cells	13
(d) Industrial flashlight cells and batteries	14
(e) Photoflash cells	15
(f) Hearing-aid batteries	16
(g) A batteries	17
(h) B batteries	18
(i) C batteries	19
(j) A/B pack batteries	20
(k) Transistor batteries	21

TABLE 12. *No. 6 Dry cells or equivalent and cells for telephone applications*

Sizes and types	Light intermittent test (1)[c]	50-ohm telephone test (2)	Alarm battery test (3)	Heavy intermittent test (4)	
				Initial	6-month delayed
	Days	*Days*	*Days*	*Hours*	*Hours*
No. 6 general-purpose[a]	200	------	------	70	65
No. 6 industrial[b]	310	500	------	100	90
No. 6 alarm	------	------	300	------	------
No. 6 "regular" telephone	300	470	------	------	------
No. 6 "special" telephone	340	625	------	------	------
Size D telephone	30	60	------	------	------

[a] Cells not otherwise specifically marked or represented by the manufacturer shall be considered as general purpose cells and tested according to the requirements thereof.
[b] This type of cell is intended for applications where highly efficient performance is required on both heavy and light services.
[c] These numbers in this and succeeding tables refer to the numbered test procedures given in section 13, Capacity Tests.

Table 13. *General-purpose flashlight cells*

Cell designation	General-purpose 2.25-ohm intermittent test (7)		General-purpose 4-ohm intermittent test (6)		General-purpose 5-ohm intermittent test (5)		Light industrial test (8)
	Initial	6-month delayed	Initial	6-month delayed	Initial	6-month delayed	
	Minutes	*Minutes*	*Minutes*	*Minutes*	*Minutes*	*Minutes*	*Minutes*
D	400	375	675	625	------	------	600
C	------	------	325	275	------	------	------
AA	------	------	80	65	------	------	------
AAA	------	------	------	------	50	40	------
N	------	------	------	------	45	35	------

Table 14. *Industrial flashlight cells and batteries*

Type designation	Industrial tests (8), (9)				Lantern tests			
	Initial		3-month delayed		16-ohm (12)		32-ohm (11)	
	1.1 Volts	0.9 Volt	1.1 Volts	0.9 Volt	Initial	6-month delayed	Initial	6-month delayed
	Minutes	*Minutes*	*Minutes*	*Minutes*	*Hours*	*Hours*	*Hours*	*Hours*
D, heavy-industrial	300	750	200	650	----	----	----	----
D, light-industrial	550	850	450	750	----	----	----	----
4F, lantern	----	----	----	----	20	15	45	40

Table 15. *Photoflash cells*

Cell designation	Photoflash test (10)	
	Initial	6-month delayed
	Seconds	*Seconds*
D	800	650
C	700	550
AA	150	120

Table 16. *Hearing-aid Batteries*

PART I. A BATTERIES

Classification and type designation		20-ohm test (13)		30-ohm test (14)		50-ohm test (15)	
Cylindrical	Flat	Initial	6-month delayed	Initial	6-month delayed	Initial	6-month delayed
		Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
AA	------	------	------	------	------	30	25
A	------	------	------	18	16	45	40
AA2	------	------	------	35	25	75	60
B	------	12	8	25	20	------	------
C	------	15	10	35	25	------	------
CL	------	35	30	70	60	------	------
CD	------	70	65	130	120	------	------
D	------	70	65	130	120	------	------
F	------	120	110	220	200	------	------
M40	------	------	------	------	------	40	35
M50	------	25	20	40	30	70	65
M55	------	30	25	55	50	95	90
M60	------	------	------	50	45	95	90
M62	------	30	25	55	50	95	90
M70	------	55	50	85	80	140	130
M72	------	50	40	80	70	135	125

PART II. B BATTERIES

Classification and type designation		1,500-ohm test (16)		3,000-ohm test (17)		6,000-ohm test (18)	
Cylindrical	Flat	Initial	6-month delayed	Initial	6-month delayed	Initial	6-month delayed
------	10F15	------	------	125	100	250	200
------	15F15	------	------	125	100	250	200
------	20F15s	------	------	125	100	250	200
------	20F15d	------	------	125	100	250	200
------	10F20	100	90	200	175	400	350
------	15F20	100	90	200	175	400	350
------	20F20	100	90	200	175	400	350
10NS	10F30	300	250	600	500	------	------
15NS	15F30	300	250	600	500	------	------
20NS	20F30	300	250	600	500	------	------
15N	15F40	525	475	950	900	------	------
22N	22F40	525	475	950	900	------	------
30N	30F40	525	475	950	900	------	------

PART III. TRANSISTOR BATTERIES

Classification and type designation		250-ohm test (19)		625-ohm test (20)	
Cylindrical	Flat	Initial	6-month delayed	Initial	6-month delayed
		Hours	*Hours*	*Hours*	*Hours*
M10	------	------	------	30	25
M12	------	------	------	60	55
M15	------	------	------	80	75
N	------	65	55	160	150
M20, 2M20	------	60	55	160	155
M25, 2M25	------	60	55	160	155
M30, 3M30	------	95	90	------	------
M35, 2M35	------	145	140	------	------
M40, 2M40, 3M40	------	195	190	------	------
M35-2	------	290	280	------	------
M40-2	------	390	380	------	------

Table 17. *A batteries*

Battery designation	5-ohm test (21)				25-ohm test (22)			
	Initial		6-month delayed		Initial		6-month delayed	
	1.1 volts	1.0 volt	1.1 volts	1.0 volt	1.1 volts[a]	1.0 volt[a]	1.1 volts[a]	1.0 volt[a]
	Hours	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*	*Hours*
F2	30	35	26	30	----	----	----	----
F4d	90	115	85	110	----	----	----	----
F6d	140	170	135	165	----	----	----	----
F8d	190	235	185	230	----	----	----	----
3D	----	----	----	----	50	70	40	60
3F, 4Fd	----	----	----	----	120	140	110	130
3G	----	----	----	----	140	170	130	160
4F2s	----	----	----	----	240	325	230	310

[a] Cutoff voltage stated as volts per cell or 1.5-volt group in series.

Table 18. *B batteries*

Battery designation		Test to be applied for 22.5-volt unit (23), (24), (25)	Initial	6-month delayed
Cylindrical	Flat			
			Hours	*Hours*
----	15F20, 20F20	22,500-ohm	100	90
----	45F25, 60F25	2,500-ohm	30	25
15NS, 30NS, 45NS	15F30, 30F30, 45F30	22,500-ohm	300	250
30N, 45N, 60N	30F40, 45F40, 60F40	22,500-ohm	525	475
30N, 45N, 60N	30F40, 45F40, 60F40	2,500-ohm	30	25
30AA	30F70	2,500-ohm	75	60
15A, 30A	15F80, 30F80	2,500-ohm	130	120
30BR	----	2,500-ohm	160	140
15B, 30B	30F90	2,500-ohm	225	210
30D	30F100	2,500-ohm	600	560
30F	----	1,250-ohm	550	500
30G	----	1,250-ohm	600	550

Table 19. *C batteries*

Battery designation	C-battery test (26)
	Months
3B, 5B, 15B	24
3D	36
200F20	12[a]

[a] Open-circuit voltage measurements to be made with a voltmeter having a resistance of at least 10,000 ohms per volt.

Table 20. *A/B pack batteries*

Battery designation	Test applied (27)	Initial	6-month delayed
		Hours [a]	*Hours* [a]
60AA/6CD	A 25-ohm test B 2,500-ohm test	75	60
60A/6F	A 25-ohm test B 2,500-ohm test	130	120
60BR/6G	A 25-ohm test B 2,500-ohm test	160	140
60D/F18	A 5-ohm test B 2,500-ohm test	600	560

[a] To 1.0 volt for each 1.5 volts of nominal A-battery voltage or to 15 volts of each nominal 22.5 volts of B battery.

Table 21. *Transistor batteries*

Battery designation		Test to be applied for each 1.5-volt unit (28), (29)	Initial	6-month delayed
Cylindrical	Flat			
			Hours	*Hours*
AA		166⅔ ohms	75	60
C		83⅓ ohms	130	120
D		83⅓ ohms	300	290
	6F25	166⅔ ohms	30	25
	6F50–2	166⅔ ohms	155	145
	6F100	83⅓ ohms	300	290

FIGURE 1.

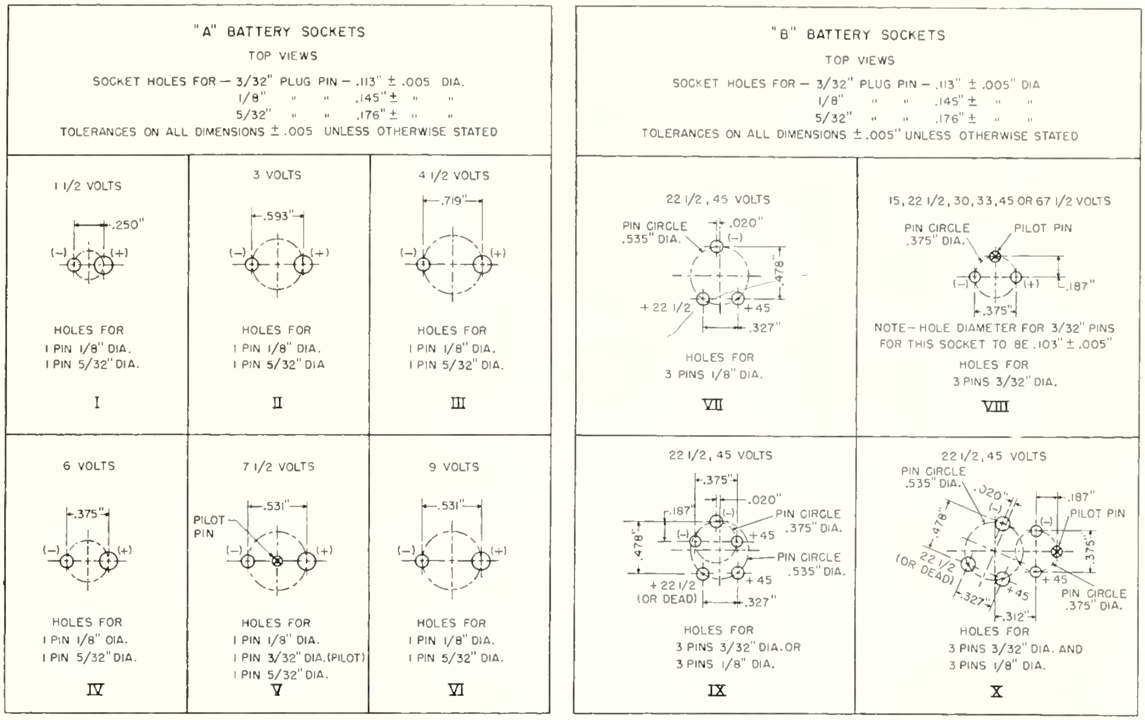


FIGURE 2.

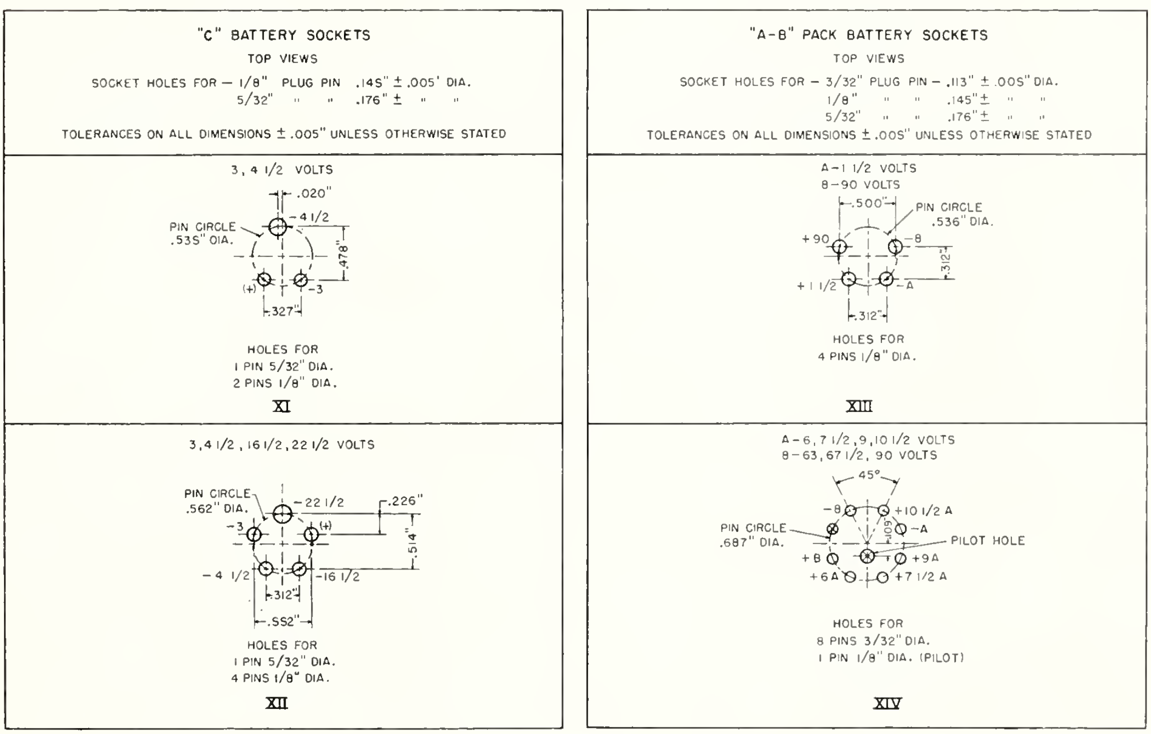


Figure 3.

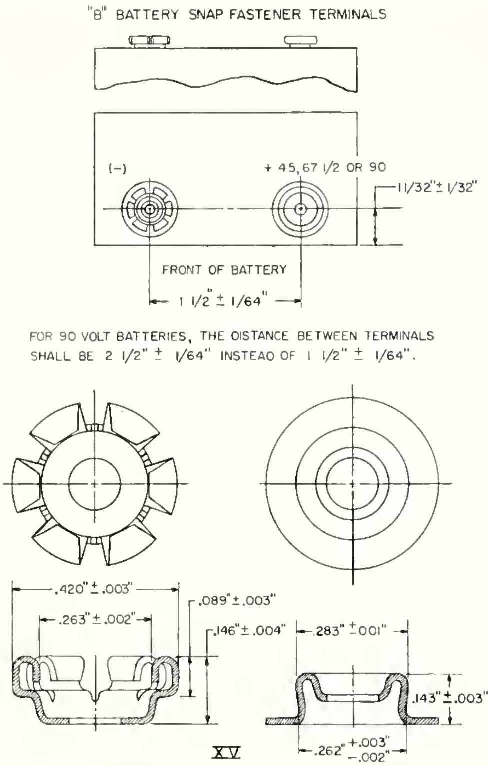


Figure 4.

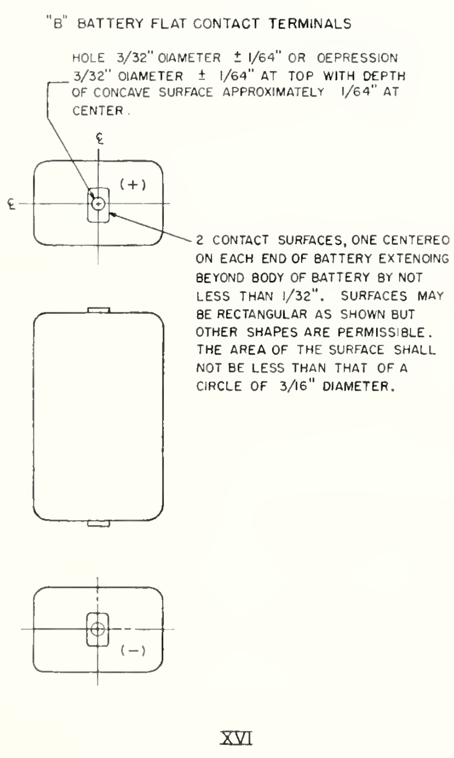


Figure 5. XVII: Miniature snap fastener terminals.
XVIII: High-voltage battery sockets.

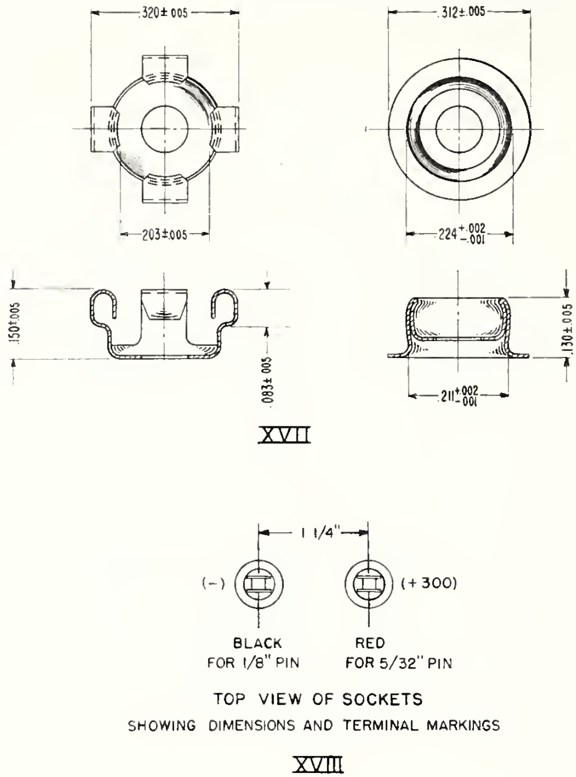
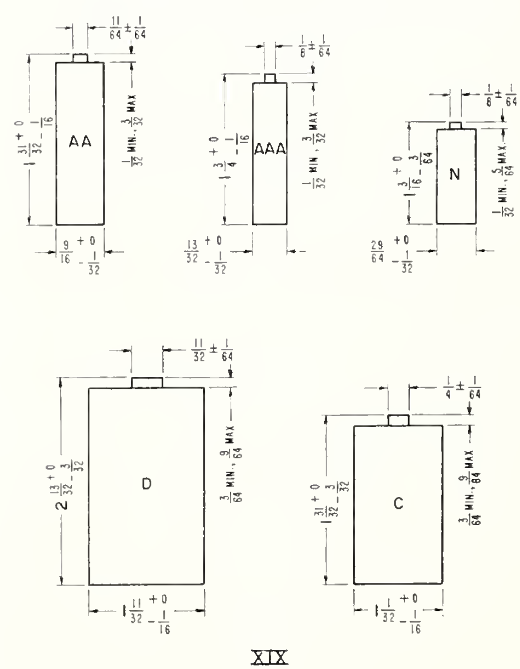


Figure 6. Transistor cell dimensions.



Washington, D.C., May 20, 1959.

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